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CENTRAL INTELLIGENCE AGENCY

INFORMATION REPORT

REPORT

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COUNTRY	USSR	DATE DISTR.	22 June 1948
SUBJECT	Permafrost	NO. OF PAGES	4
PLACE ACQUIRED	USSR	NO. OF ENCLS. (LISTED BELOW)	
DATE OF INFORMATION	1946	SUPPLEMENT TO REPORT NO.	

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THIS IS UNEVALUATED INFORMATION FOR THE RESEARCH USE OF TRAINED INTELLIGENCE ANALYSTS

SOURCE Russian periodical, Trudy Instituta Merzlotovedeniya imeni V. A. Obrucheva, Vol I, 1946. (Information specifically requested.)

HOUSING AND LIGHT INDUSTRIAL CONSTRUCTION IN PERMAFROST REGIONS

[The following are summaries of each of the articles edited by A. Chekotillo, Acting Director of the Institute.]

"Some Features of Dwelling-House Foundations in the Northern Parts of the Permafrost Region," V. F. Fumel', 21 pp

On the basis of investigations carried out in the Dudinka, Igarka, and Anadyr regions, the author concludes that permafrost under wooden dwelling houses and similar buildings in the northern portions of the permafrost area may be preserved without thawing during the summer months.

A low fill arranged along the socle of a building helps to keep the ground beneath the foundation in a frozen condition all year round. When this fill is used, no cellar is necessary.

The writer compares various climatic factors with the thermal conditions of permafrost in northern and southern regions of the USSR permafrost area.

The investigations resulted in the conclusion that the thermal status of permafrost under buildings depends on various climatic elements in different regions; in some cases the snow cover has the greater influence; in others, the insolation, etc. On the other hand, the seasons are not equal in their influence; in some regions of the permafrost area the winter season controls the whole heat balance of the permafrost, while the influence of the summer heat is prevalent in other regions.

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"Construction and Maintenance of Small Industrial-Building Foundations in the Dudinka Region," G. O. Lukin, 74 pp

The author reports the results of observations on the underground structures of two small power-plant buildings and of a brick kiln.

The observations were carried out during the construction and two years of operation. In constructing the brick kiln and one of the power-plant buildings, steps were taken to preserve the permafrost condition of the ground. Another powerplant building, a provisional structure, was built by customary methods without taking into consideration the thermal effect of the boiler furnace on the permafrost subsoil.

It has been observed that proper design, suitable construction methods, and reliable thermal insulation of underground structures are of greatest importance under permafrost conditions. The maintenance also has a great part in the stability of buildings in these regions, and careful drainage of melting snow, rain, and industrial waters is very important.

"Building Foundations at Yakutsk," N. I. Saltykov, 34 pp

The article contains data on the types and construction of the more interesting buildings constructed in Yakutsk during the past 200 years.

Stone buildings erected according to usual technical norms, without taking into account the permafrost, in most cases have been considerably deformed.

On the basis of practical experience, the local builders have evolved the following requirements for erecting stone buildings: (1) choice, for such buildings, of dry, sandy, elevated, well-drained areas; (2) deep foundations in the permafrost; and (3) massive forms with great reserves of strength.

In accordance with the severe climate and low temperature of the permafrost, the principle of construction at Yakutsk is the preservation of the ground beneath the foundations in a permafrost state.

It has been shown that by constructing buildings with a moderate formation of heat, for example, dwellings, schools, etc., it is sufficient to construct the usual cellars and to avoid placing stoves on the stone foundations to preserve the permafrost. In comparison with the thermal regime of the ground under natural conditions, the thermal regime beneath such buildings shows the following particular features: (1) an increase of the average annual temperatures; (2) a decrease of the amplitude of seasonal variations; and (3) a lowering of maximal temperatures.

In connection with these changes, the surface of the permafrost beneath such buildings not only maintains its level, but at times rises.

In the case of industrial buildings with greater heat production, it is necessary to build them with readily ventilated cellars, substituting separate supports for compact wall foundations.

During recent years some buildings of this type were constructed in Yakutsk according to the suggestion of Professor N. A. Tsitovich. In spite of unfavorable ground conditions, all of them are in quite satisfactory states.

Intensive thawing of the permafrost is observed under heated buildings entirely without cellars, i.e., with the floor placed directly on the ground, and also around underground and semi-underground buildings.

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The wooden houses of Yakutsk stand well without deformation. They are constructed on wooden pillars driven one or two meters into the earth.

The construction of wooden buildings in Yakutsk has remained almost the same for about 150 years.

"The Temperature Field Laws of the Permafrost of the Vorkuta District," D. V. Redozubov, 31 pp

The investigation was based on a geophysical interpretation of permafrost, which is conceived of as the existence of a negative temperature field below the surface of the zero annual amplitudes in the upper layer of the lithosphere.

Because of altering factors, the temperature field down to the boundary of the zero annual amplitudes does not represent a Fourier field and is excluded from the following analysis.

The investigation is limited to the solution of two problems:

The solution of the first problem permits the calculation of the time necessary for the inception of the linear law of the distribution of temperature in the bulk of the permafrost in the case of a change of the temperature on the surface of the zero annual amplitudes, the lower boundary of the permafrost remaining constant. This time is called a "stationary" time.

The study of the temperature curves from this point of view can give additional data for historical climatology.

The temperature field of the permafrost has specific peculiarities resulting from the thawing of ice or the freezing of water. Therefore, the bulk of the permafrost has a thermal inertia.

Due to this inertia, the series of climatic changes does not coincide in time with the series of frost changes. These series may diverge in time by ten thousands of years. With the change of climate, different gradients set in in the frozen bulk and in thawed rocks beneath the latter. Therefore, we observe a sharp bend on the temperature curve. Two types of such bends are possible. One of them was revealed by measuring the temperature in a shaft of the Vorkuta district.

The second problem differs from the problem of Stephan, and allows the calculation of two factors: (1) the isogradient time, during which the thickness of the frozen ground corresponding to the given climate is established; and (2) the thickness of the permafrost.

The thickness of the **permafrost** corresponding to the given climate is called "stationary."

The difference between the actual and stationary thickness serves as a measure of the "unstationarity" of the temperature field. Its value and sign show the direction of the dynamics of the permafrost.

The nature of the dynamics of the permafrost consists of the following: (1) the change of the temperature on the surface of zero annual amplitudes; (2) the settling of a stationary temperature distribution within the negative field and a small change of the position of the lower surface of the permafrost; (3) the further change of the lower surface of the permafrost, completed during the isogradient time; and (4) the change of the gradient in the bulk of the permafrost.

A complete degradation of the permafrost will take place when the upper surface of the permafrost is isolated from winter freezing.

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The temperature will soon approach zero throughout the whole bulk of the permafrost. Afterwards the ice begins to disappear from above and from below, and the permafrost disappears.

The contemporary climate usually maintains already existing permafrost. It is only on the boundaries of permafrost regions that it may give rise to a new formation of permafrost or its complete disappearance.

All the general laws of the temperature field apply to the temperature field of the permafrost of the Vorkuta district. The analysis of the temperature field gives the additional fact that the temperature field must be considered as a space temperature field.

The problem of the space temperature field of the permafrost may be confined to the boundary problems of mathematical physics. For example, when the temperatures on the surface of zero amplitudes and the lower surface of the permafrost are constant, the temperature field of the permafrost may be formulated as Dirichle's space problem.

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